EXECUTIVE SUMMARY

STATUS AND CONSERVATION OF WHITEBARK PINE

USDA FOREST SERVICE, REGION 1
SEPTEMBER 20, 2010 (rev. 10dec2010)

This executive summary addresses the status and conservation of whitebark pine (*Pinus albicaulis*) in Region 1 (Northern Region) of the U.S. Forest Service (hereinafter referred to as Region 1), and is organized by the topics specified in the Federal Register Notice. The numbered sections below provide summary information under each topic. If applicable, appendices are referenced in these sections. The appendices will be submitted separately via DVD to the USFWS Cheyenne Ecological Services Field Office. A separate DVD containing GIS files will also be submitted directly to the Cheyenne Field Office.

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The status of the species

Historic and current range

1. **Overview of species status and distribution in Region 1** (Shelly, Nock)

Whitebark pine occurs on all 12 national forests in Region 1 in Montana and northern Idaho. The species is currently mapped as occurring on 5,085,904 acres of National Forest System lands in Region 1, which is 20.06% of the 25,353,162 acres of NFS lands in the region. Its distribution in Region 1 encompasses the full range of settings in which whitebark pine occurs, from mixed conifer stands at lower elevations where it occurs as a minor early-successional component, to sites at upper elevations where it exists as a dominant climax species.

A map of the current distribution of whitebark pine in USFS Region 1 is being provided separately, via a DVD with GIS files, to the Cheyenne field office. It is important to note that this map includes all portions of the range where whitebark pine is a minor stand component; as such, it represents the total distribution of whitebark pine in Region 1. A separate map is being developed that will display the areas in Region 1 where whitebark pine is the dominant species, and will be submitted to USFWS upon completion.

Historic and current population levels, and current and projected trends

2. **Abundance and trend data for Whitebark Pine in USFS Region 1** (Bollenbacher)

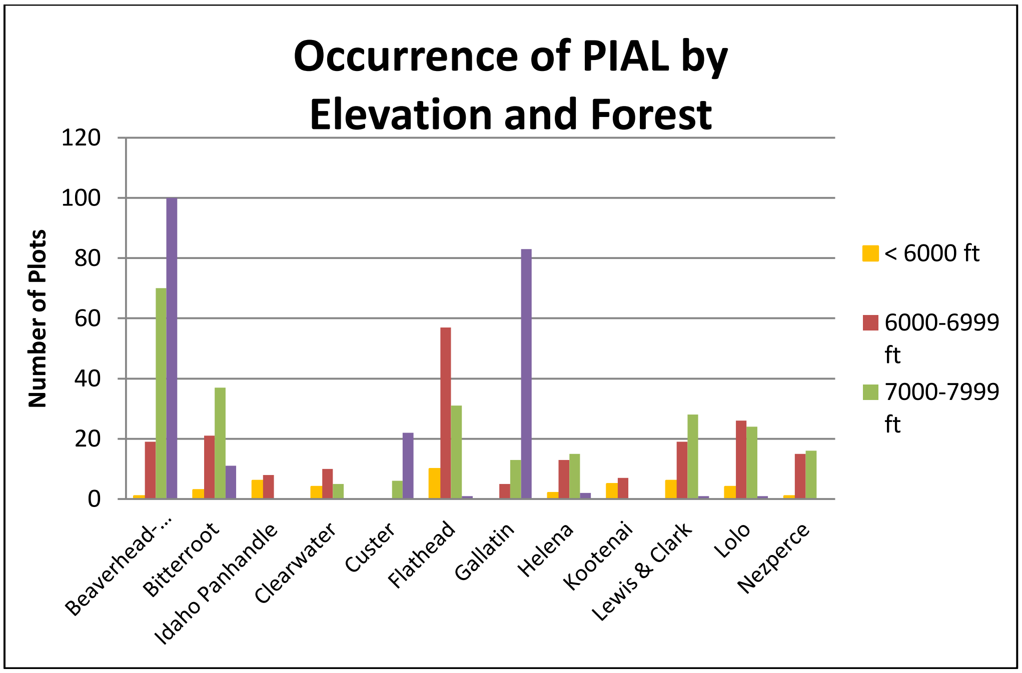
Region 1 utilizes a multi-level Classification, Inventory and Mapping system to provide abundance and trend information for our vegetation species composition, structure, and pattern across the approximately 25 million acres (21 million acres forested) of National Forest land. At the broad level we utilize the Forest Inventory and Analysis (FIA) grid plot survey, and have extended the measurement onto the non-forest portion of the Region to assess quantitatively the current condition and trend of vegetation. See **Section 14** for a complete discussion of trend data obtained from the FIA information. We also use remotely sensed map products such as R1 VMAP to evaluate the spatial pattern of vegetation.

At the fine scales we use vegetation plots using the R1 Common Stand Exam to inventory specific forest stands for specific reasons. In addition, we have installed a series of permanent growth plots to assess long-term changes in specific locations to address specific issues such as progression of root disease and white pine blister rust.

Abundance

FIA plot data were explored to look at the occurrence of whitebark pine by elevation classes. The distribution of whitebark pine closely follows elevation bands linked to cooler temperatures within the various National Forests in the Northern Region (Figure 1).

Figure 1: Occurrence of whitebark pine (either live or dead) by elevation classes and Forests.



At the broad Regional and Forest scales, the FIA abundance information from the 1990s periodic inventory, and preliminary information on trend from the annualized inventory (2002-2007 data) shows a reduction of the extent of live whitebark pine (plots having at least one tree) across the Region and Forests, and an increase in dead trees. Given the fact that the annual data cycle has 10% of the plots measured each year, and we have not completed an entire cycle yet, these trends are preliminary in nature but the trajectory is evident. The bulk of the mortality can be attributed to ongoing mortality from white pine blister rust, wildfire, and the mountain pine beetle (only since about 2004 has mortality increased at a rapid rate). The likelihood of continuing mortality due to these disturbance agents, in the case of mountain pine beetle and fire, is very much linked to the future cyclic pattern of warm weather and drought at higher elevations where whitebark pine is abundant. Mortality due to blister rust will continue for the foreseeable future regardless of the near-term climate cycles.

Table 1 indicates the percentage of the total FIA plots, for Region 1 and each National Forest, which contain whitebark pine. In the first chart, 18.3% of the Region 1 FIA grid plots (from the 1990s periodic inventory) contained live WBP. The second chart, based on the annualized inventory from 2002-2007, shows that 15.8% of the plots contained live whitebark pine.

Table 1: Number and percent of Periodic and Annual FIA plots, for Region 1 and by Forest, with live, dead, and both live or dead whitebark pine (PIAL) trees.

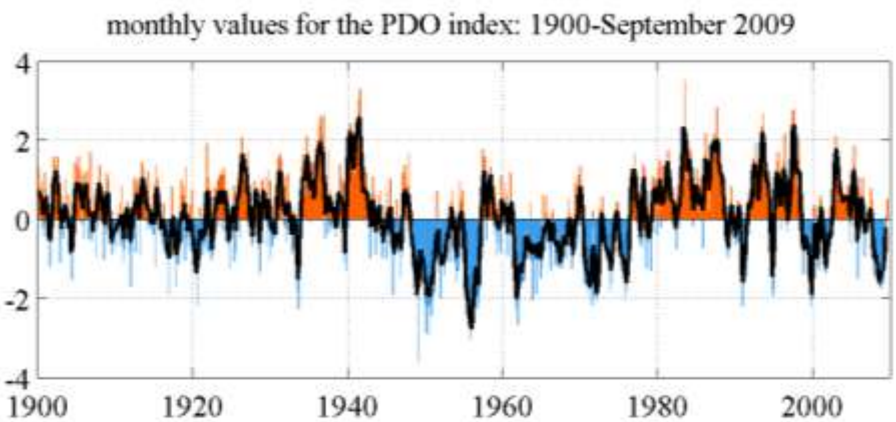
Periodic FIA									
	Live PIAL			Dead PIAL			Live and/or Dead PIAL		
	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL
R1	709	3875	18.3%	330	3875	8.5%	736	3875	19.0%
Beaverhead-Deerlodge	194	546	35.5%	75	546	13.7%	194	546	35.5%
Bitterroot	75	252	29.8%	34	252	13.5%	78	252	31.0%
IPNF	13	411	3.2%	4	411	1.0%	16	411	3.9%
Clearwater	14	305	4.6%	11	305	3.6%	17	305	5.6%
Custer	27	195	13.8%	13	195	6.7%	29	195	14.9%
Flathead	94	382	24.6%	59	382	15.4%	99	382	25.9%
Gallatin	112	285	39.3%	45	285	15.8%	114	285	40.0%
Helena	31	149	20.8%	13	149	8.7%	31	149	20.8%
Kootenai	8	365	2.2%	3	365	0.8%	9	365	2.5%
Lewis & Clark	53	299	17.7%	24	299	8.0%	56	299	18.7%
Lolo	60	347	17.3%	29	347	8.4%	61	347	17.6%
Nez Perce	28	339	8.3%	20	339	5.9%	32	339	9.4%
Annual FIA									
	Live PIAL			Dead PIAL			Live and/or Dead PIAL		
	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL
R1	302	1914	15.8%	199	1914	10.4%	332	1914	17.3%
Beaverhead-Deerlodge	92	291	31.6%	46	291	15.8%	95	291	32.6%
Bitterroot	28	128	21.9%	19	128	14.8%	32	128	25.0%
IPNF	2	164	1.2%	0	164	0.0%	2	164	1.2%
Clearwater	6	124	4.8%	4	124	3.2%	7	124	5.6%
Custer	9	90	10.0%	5	90	5.6%	10	90	11.1%
Flathead	39	189	20.6%	38	189	20.1%	48	189	25.4%
Gallatin	47	166	28.3%	35	166	21.1%	49	166	29.5%
Helena	15	80	18.8%	7	80	8.8%	15	80	18.8%
Kootenai	4	203	2.0%	4	203	2.0%	5	203	2.5%
Lewis & Clark	27	152	17.8%	18	152	11.8%	31	152	20.4%
Lolo	26	184	14.1%	20	184	10.9%	30	184	16.3%
Nez Perce	7	143	4.9%	3	143	2.1%	8	143	5.6%

Distribution of large trees (as evidenced by high basal areas of trees over 3”), and current distribution of regenerating whitebark pine, will be submitted as **Appendix A**. This information will show where the “strongholds” of mature whitebark pine are by elevation and Forest, and where regeneration is prevalent.

Trend
The bulk of the mortality showing up in the second chart can be attributed to ongoing mortality from white pine blister rust, wildfire, and the mountain pine beetle (only since about 2004 has MPB-related mortality increased at a rapid rate). As stated above, projection of continuing mortality due to these disturbance agents, in the case of mountain pine beetle and fire, is very much linked to the pattern of warm weather and drought at higher elevations where WBP is abundant. The pattern of these disturbances over the past 100 years has coincidently occurred during the warm phase of the Pacific Decadal Oscillation (PDO).

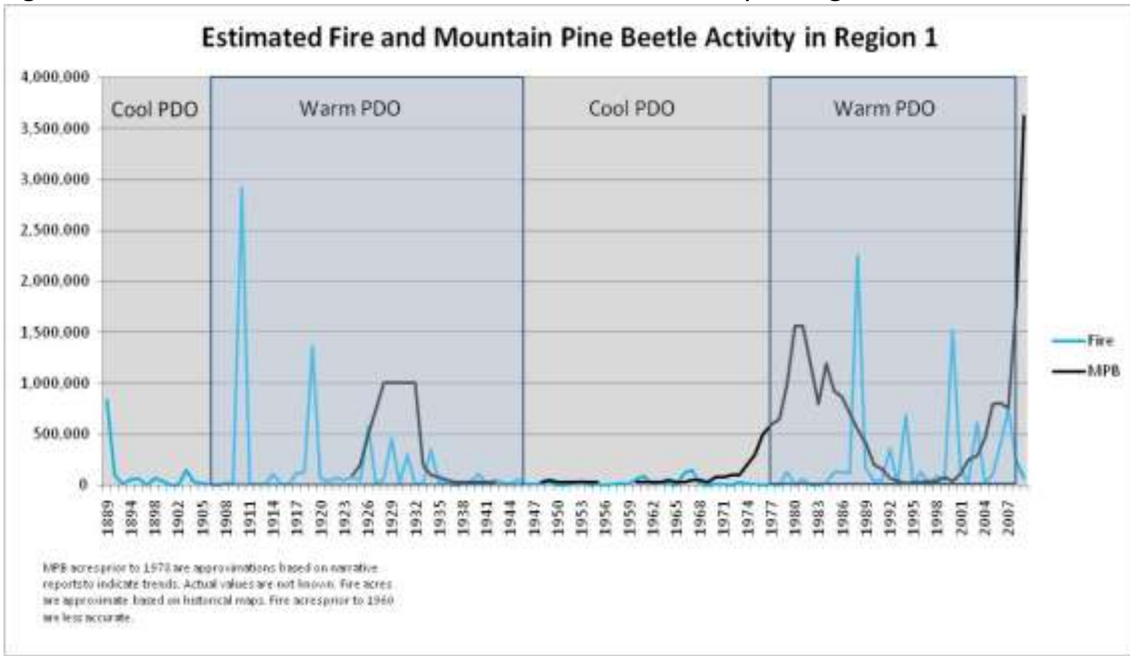
The Pacific Decadal Oscillation effects are determined by northern Pacific surface water temperatures, and influence climatic trends across the northern Rockies and Great Plains. An index for the PDO was developed to track the trend of these temperatures over time, as shown in Figure 2.

Figure 2. Chart of monthly values for the PDO index: 1900-September-2009



Over the last century in Montana and northern Idaho, it is evident that the PDO, influencing the western regional climate including the Region One area, has also influenced disturbances such as fire and mountain pine beetle (see Figure 3).

Figure 3. Estimated Fire and Mountain Pine Beetle Activity in Region 1



There have been three outbreaks of mountain pine beetle during this time. The first one in the 1920s-30s killed significant areas of whitebark pine in the Gallatin and Beaverhead National Forests and left many "Ghost Forests" as shown in Figure 4 (Evenden 1934; Evenden 1944). As quoted by a Park Ranger in 1934, "(t)he mountain pine beetle epidemic is threatening all of the whitebark and lodgepole pine stands in Yellowstone Park. Practically every stand of whitebark pine is heavily infested…and will be swept clean in a few years." Another interesting remark from that same time period was: "(t)he intensive fire protection of overmature lodgepole pine stands is not improbably producing a condition favorable to widespread epidemics of the mountain pine beetle" (Craighead, 1925).

Figure 4.

The second outbreak was in the 1970s-80s in northwest Montana and south-central Montana. The third one began in 2001 and has been killing significant areas of whitebark pine over the last few years in southwestern, south, and central Montana. The conditions for this outbreak began with large-scale disturbances from the 1880s-1930s that regenerated to a young forest condition over millions of acres in northern Idaho and Montana. The subsequent cool PDO, coupled with aggressive fire suppression activity from the late 1930s to 1980, allowed the young forest to develop into a forest susceptible to mountain pine beetle all at the same time over a very large area. All of the major fire years in Region 1 have occurred during the warm phase of the PDO. It is not currently known what causes the PDO to change, nor is there current knowledge on how possible global climate change may interact with the PDO.

Given that the probability of continuing disturbance is high as climate projections predict a warming trend, the mortality of large seed-producing whitebark pine may also be high. Thus, restoration efforts to encourage natural regeneration of whitebark pine are urgently needed soon, to take advantage of large cone-bearing rust resistant trees while they are still on the landscape. Planting of stock from the whitebark pine rust resistance work is also important to continue.

Literature Cited:

Craighead, F.C. 1925. The Dendroctonus problems. J. Forestry 23: 340-354.

Evenden, J.C. 1934. History of the mountain pine beetle infestation in the lodgepole pine stands of Montana. USDA Bureau of Entomology Forest Insect Investigation Report, Forest Insect Laboratory, Coeur d'Alene, Idaho. 29p.

Evenden, J.C. 1944. Montana's thirty-year mountain pine beetle infestation. USDA Forest Service, Northern Region, Insect Reports. 16p.

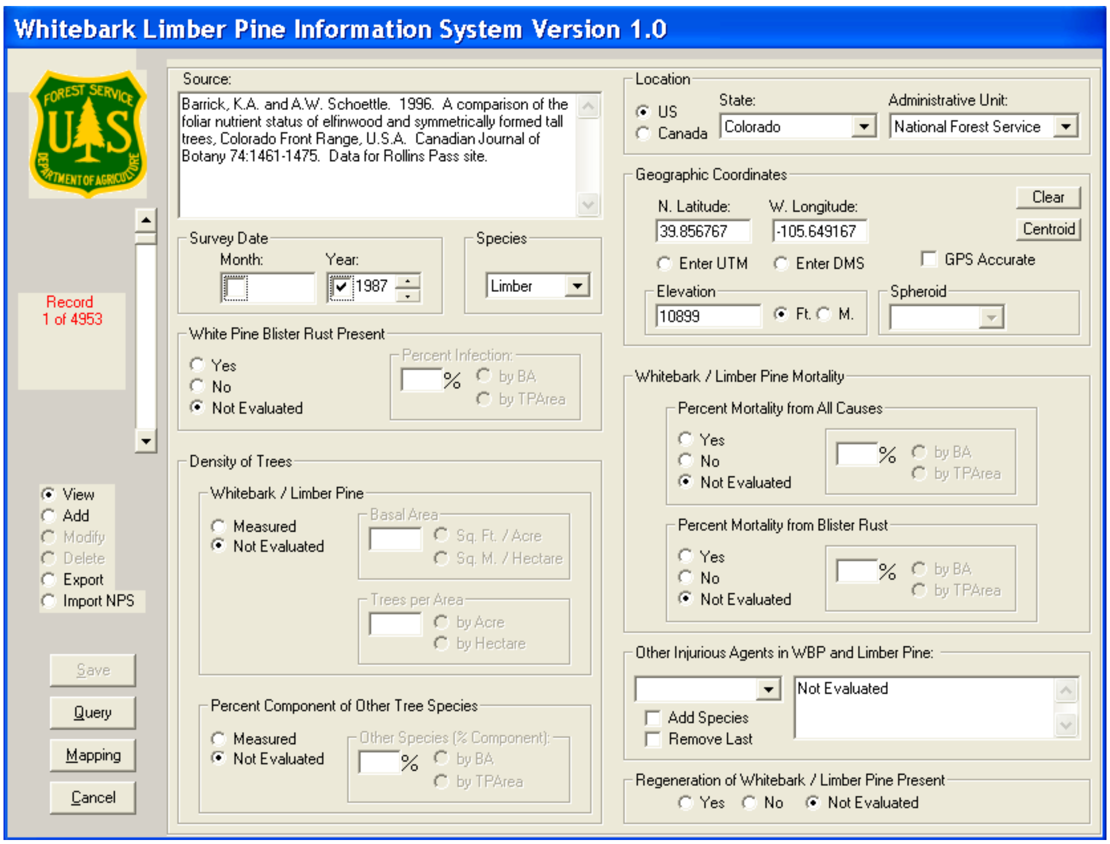
3. **WLIS: Whitebark-Limber Pine Information System** (Lockman)

The development of the Whitebark and Limber Pine Information System (WLIS) was a cooperative project between USFS Forest Health Protection; USFS Forest Health Technology and Enterprise Team, Fort Collins; USFS Rocky Mountain Research Station Fire Lab; Colorado State University; University of Colorado at Denver; and Whitebark Pine Ecosystem Foundation. The first version was completed and released in 2005. WLIS has since been used in a number of assessments, including "A Range-Wide Restoration Strategy for Whitebark Pine" (Keane *et al*. 2010).

WLIS is a database of basic plot information on whitebark and limber pines from the numerous surveys and studies that have been completed in the US and Canada. This compilation of summary data permits rangewide assessments of whitebark and limber pines. Forest Inventory and Analysis (FIA) plot data are part of the database. The data can be queried to provide a spatial summary of the condition of these two species. The US National Park Service has created an interface for simplifying entry of future survey/study data by individuals, using the survey design developed by the Whitebark Pine Ecosystem Foundation as a template.

There are three main components associated with WLIS. The first is an interactive interface that allows for the easy entry and validation of data and review of data already in the database (Figure 5). Almost 5,000 records have been gathered and entered into the database. Additional data can be entered into the user's own copy of the database. This can either be through direct entry via the interface or by collecting data utilizing the US National Park Service database (Frakes and Pilmore 2004) and importing it directly into WLIS.

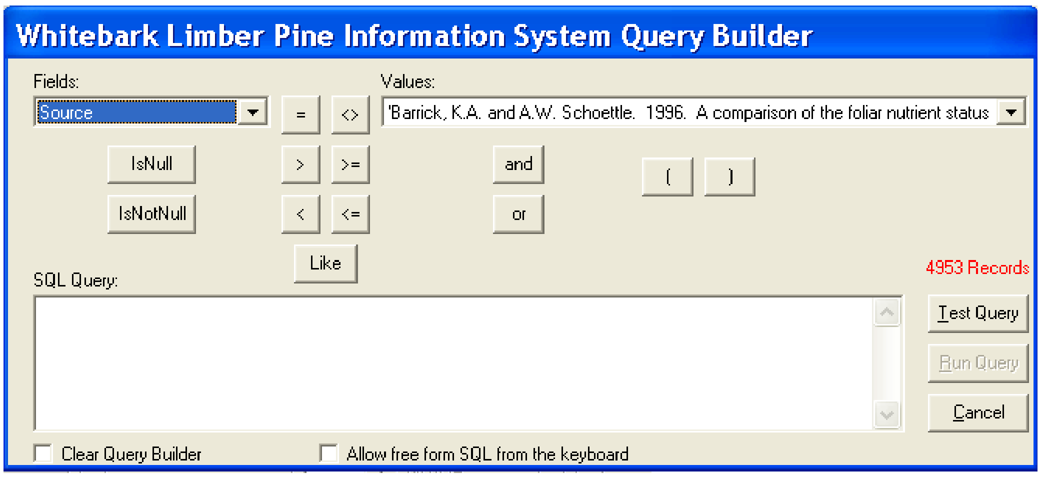
Figure 5.



WLIS interactive interface. Users can enter and edit their own data, or import from USNPS tree data entry program.

The second component of WLIS is its query builder (Figure 6). This tool allows the user to easily construct queries of the data. Queries can be built for any of the variables included in the database, as either individual elements or combined. The results of a query can be viewed through the mapping application, and can also be exported through the interface into a commercially available spreadsheet.

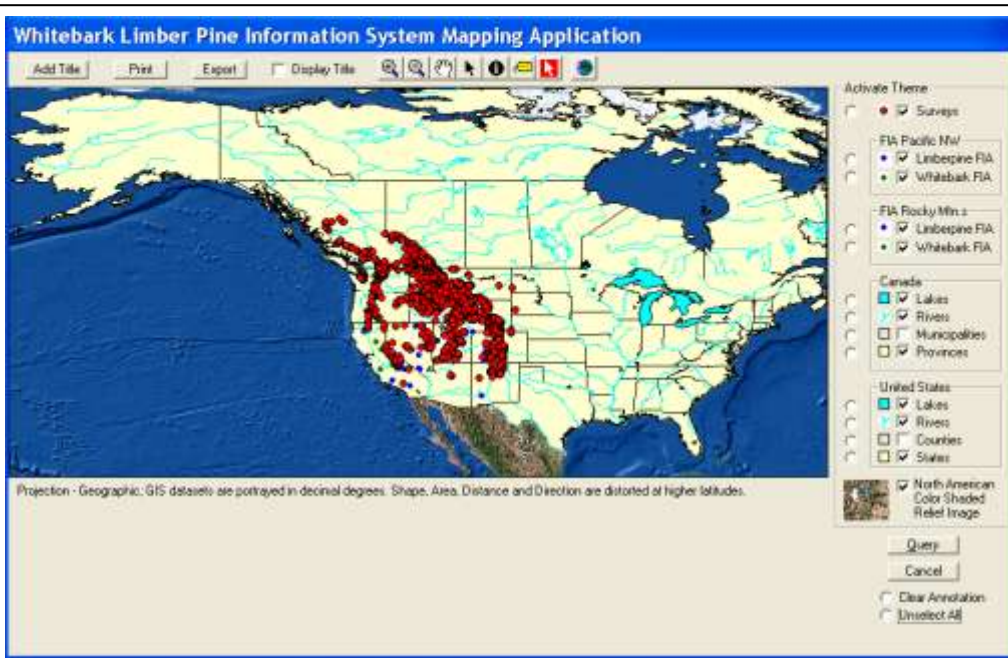
Figure 6.



WLIS query builder. The user can query all data in the database using the existing fields, or by using free form SQL from the keyboard. Query results can also be viewed through the mapping application.

The third component is the GIS mapping ability of the program (Figure 7). Selected plots can be mapped along with other spatial components. The survey plot locations can be viewed along with FIA inventory plot locations. This component of WLIS has limited GIS capabilities, but geospatial data can be exported and used in more advanced GIS software.

Figure 7.



WLIS mapping application. Plot locations are spatially depicted through an interactive mapping system. The interactive database provides a user-friendly interface for the addition of new plots or updating data for plots already in the system.

WLIS can be easily downloaded from the Northern Region FHP web site:
http://www.fs.fed.us/r1-r4/spf/fhp/prog/programs2.html

The version currently available does not include all updates. For the most current version of the database and for further discussion, please contact Gregg DeNitto (gdenitto@fs.fed.us) or Blakey Lockman (blockman@fs.fed.us). USFS Forest Health Protection is in the process of developing a proposal for updating WLIS to include all high-elevation 5-needle pines; to improve the geospatial program and display; and to make the database available for data entry via the internet.

Literature Cited:

Keane, R.E., D. Tomback, C. Aubry, A. Bower, E. Campbell, M. Jenkins, M. Manning, S. McKinney, M. Murray, D. Perkins, D. Reinhart, C. Ryan, A. Schoettle, and C. Smith. 2010. A range-wide restoration strategy for whitebark pine (*Pinus albicaulis*). General Technical Report RMRS-GTR-XXX. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. XXX pp.

Frakes, B., and D. Pilmore. 2004. Whitebark pine blister rust survey database application and manual. Beta Test Version 0.20. US National Park Service, Rocky Mountain Inventory and Monitoring Networks, Fort Collins, CO.

Past and ongoing conservation measures

4. **Integrated Restoration and Protection Strategy – Scenario 2a: identification of whitebark pine priority treatment opportunities at the Regional Scale** (Bollenbacher)

The Northern Region Integrated Restoration and Protection Strategy (IRPS) provides information to help local units identify and prioritize potential areas for accomplishing Forest and Grassland Plan goals and objectives. It is intended to assist local units to develop and prioritize integrated projects addressing land and water restoration, community protection plans, and sustainable and desirable conditions as described in Forest and Grassland management plans. It provides resource information including values such as whitebark pine (WBP), which may be vulnerable to specific agents of change including disturbance hazards, to help units develop integrated projects and in areas where we can be most successful in view of limited budgets, to accomplish priority restoration needs. Nineteen Region wide key values at risk have been identified and featured in the IRPS and are associated with six Themes in our R1 Ecosystem Management Decision Support (EMDS) model. These themes include:

- Restoration of forests, grasslands, and human communities to a more resilient condition.
- Restoration and maintenance of resilient, high value watersheds.
- Restoration of high value fisheries streams developing more resilient habitat.
- Restoration and maintenance of wildlife habitats, including restoration of more resilient vegetation conditions where appropriate, to meet ecological and social goals.
- Restoration and protection of recreation sites and scenic vistas.

- Protection of people, structures and community infra-structure (roads, trails, bridges, power corridors, recreational developments etc.)

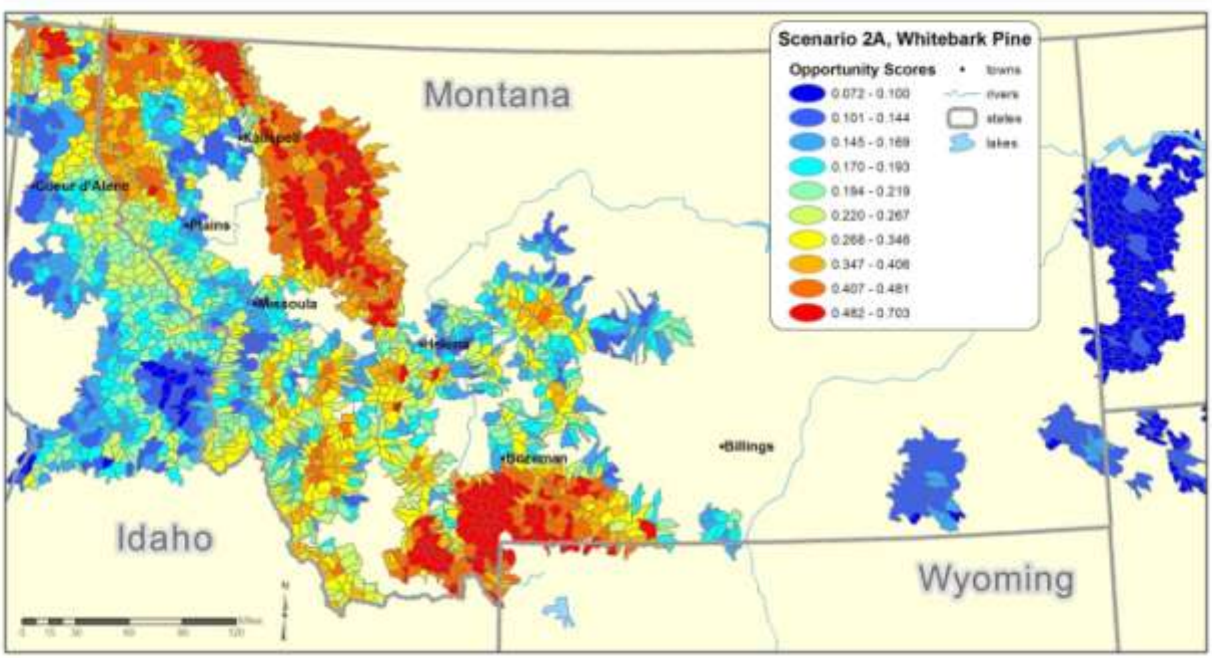
Whitebark pine is addressed in Scenario 1b (forest resiliency) and featured in Scenario 2a under theme 2 Terrestrial Species Habitats. **Appendix B** includes additional details regarding IRPS Scenario 2a.

Scenario 2a (WBP), the decision model framework for the identification of priority opportunities, is:

(50)	Value:	Whitebark pine composition, % HUC6 (30%)
		Grizzly bear species range (20%)
(35)	Risk:	Crown fire burn probability (15%)
		Blister rust damage map (10%)
		Insect occurrence from ADS, past 5 years (10%)
(15)	Feasibility:	Non-wilderness (10%)*
		MTBS mod/high burn severity (5%)

Primary treatments: The primary treatment opportunities under this strategy include prescribed burning and wildland fire use for resource benefits (to promote seed dispersal by Clark's nutcrackers for natural regeneration and to reduce crown fire potential), and planting of rust-resistant stock in areas where seedbeds have been previously prepared by fire and where local seed source is now limited. Priority opportunity focus areas are shown in Figure 8.

Figure 8. Priority opportunity focus areas.



5. **A Range-wide Restoration Strategy for Whitebark Pine (*Pinus albicaulis*)** (Keane et al., Manning)

The USFS Rocky Mountain Research Station, in collaboration with academic and agency partners, has compiled a draft rangewide restoration strategy for whitebark pine (Keane et al., 2010). The abstract is provided here, and the draft strategy is provided as **Appendix C**.

ABSTRACT

Whitebark pine has been declining in both the U.S. and Canada since the early 20th century from the combined effects of mountain pine beetle outbreaks, fire exclusion policies, and the spread of the exotic disease white pine blister rust. Within the last decade, with major upsurges of pine beetle and increasing damage and mortality from blister rust, the cumulative whitebark pine losses have altered high elevation community composition and ecosystem processes in many regions. Whitebark pine functions as a keystone species because of its various roles in supporting community diversity and as a foundation species for its roles in promoting community development and stability. Since over 90 percent of whitebark pine forests occur on public lands in the U.S. and Canada, maintaining whitebark pine communities requires a coordinated and trans-boundary effort across federal and provincial land management agencies to develop a comprehensive strategy for restoring this declining ecosystem. This report presents a range-wide strategy for maintaining whitebark pine populations in high mountain areas, based on the most current knowledge available on the efficacy of techniques and variation across communities. The strategy is organized into six scales of implementation, with assessment factors, restoration techniques, management concerns, and examples presented at each scale. At the coarse scales, the examples provided are actually broad scale restoration plans for whitebark pine. This report was written as a guide for planning, designing, implementing, and evaluating fine scale restoration activities for whitebark pine by public land management agencies, and to encourage interagency coordination and efficiency.

6. **Genetic restoration program** (Mahalovich)

The first genetic restoration program for whitebark pine began in the Inland West in 1991, with the Phase I portion leading to a blister rust screening trial and common garden study for Idaho, Montana, eastern Washington, and northwestern Wyoming seed sources at the Coeur d'Alene Nursery (Mahalovich *et al*. 2006). Provisional seed transfer guidelines and operational cone collection guidelines for the Inland Northwest populations of whitebark pine were defined based on blister rust infection levels and species distribution (Mahalovich 2000; Mahalovich and Hoff 2000). Results of the common garden study characterize whitebark pine as having a generalist adaptive strategy, and seed transfer guidelines have been revised to reflect the patterns of genetic variation in adaptive traits (Mahalovich in review). Family heritabilities, or that portion of the genetic variation that can be passed on to its progeny through selection and breeding, are moderate to high for survival, height, cold hardiness, and rust resistance (0.68-0.99). Data were collected on 16,187 10-yr old seedlings in the USFS' first long-term whitebark pine blister rust performance test at the Lone Mountain Tree Improvement Area, Idaho Panhandle National Forests, in 2009. These data provide insight into the genecology and adaptive strategy relative to climate change and stability of family and rust resistance traits over time. Moreover, each unit has a 10-year seed procurement plan, where planning for large-scale disturbance, in this case mountain pine beetle epidemics and catastrophic fire, is akin to positioning ourselves to have enough seed on hand for climate change, as the severity of both mountain pine beetle and fire are attributed to warming trends and drought conditions. The Phase II portion of the program was initiated in 2001, following the catastrophic high elevation fires in 2000.

This was a joint endeavor of the USDA Forest Service Northern (R1), Rocky Mountain (R2), and Intermountain (R4) Regions, USDI Glacier, Grand Teton and Glacier National Parks, and USDI Bureau of Land Management in Idaho, Montana, and Wyoming (Mahalovich and Dickerson 2004). Approximately 898 plus tree selections have been made among seven seed zones. A molecular genetic analysis, in collaboration with the USFS National Genetics Laboratory in Placerville, California, shows high levels of genetic diversity ($\boldsymbol{H_e}$ = 0.271) relative to other conifers in the same forest cover type (Mahalovich and Hipkins *in review*) and comparable to the *most* genetically diverse species, aspen. Another surprise finding was the high number of migrants ($\boldsymbol{N_m}$ = 9.354) indicating a lack of inbreeding. There is both sufficient genetic variation and genetic diversity to support the continuation of a rust resistance screening and genetic restoration program for this species. Two rust screenings of 39,000 seedlings are underway for four seed zones at Couer d'Alene Nursery. Four orchards are under development on the Clearwater (BTIP), Gallatin (GYGT), Lewis & Clark (CLMT), and Lolo NFs (SKCS). The North Fork orchard on the Lolo NF is the first whitebark pine seed orchard in the US, with its inaugural planting of 0.4 acres in the fall of 2009; first-year conelets were visible on grafts in July 2010. Overall the Inland West Genetic Restoration Program is closely approaching completion of its first generation of improvement. Budget data from 1991-present shows $2,253,600 have been spent in support of the genetics program ($2,070,900 NFS; $155,700 FHP; $27,000 National Arbor Day Foundation) in Regions 1, 2 and 4. A more detailed summary of the genetic restoration program is provided in **Appendix D**.

7. **Nursery Program** (Mahalovich)

The U.S. Forest Service (USFS) Northern Region began the first cone collections in 1991. Twenty-six lots were collected on the Bitterroot (1), Custer (17), Gallatin (6) and Lewis & Clark (2) National Forests in Montana. Individual-tree and bulked collections continued through 1997, leading to a blister rust resistance screening and common garden study, at the Coeur d'Alene Nursery, for Idaho, Montana, eastern Washington, and northwestern Wyoming (Mahalovich *et al*. 2006). The nursery management information system (NMIS) currently shows 27 operational lots with a total weight of 746 lbs. for restoration planting needs in the Northern, Rocky Mountain, and Intermountain Regions of the USFS. Assuming 80% germination and a planting density of 300 trees per acre, the operational seed inventory would plant up to 3,133 acres. The Inland West Whitebark Pine Genetic Restoration Program has 1,787 lots in storage, totaling 1,229 lbs., among cooperators in the Northern, Rocky Mountain and Intermountain Regions of the USFS, USDI Bureau of Land Management, and USDI National Park Service (Glacier, Grand Teton and Yellowstone National Parks). The genetics seed inventory is dedicated to blister rust resistance screening, molecular genetics testing, rootstock production for seed orchards, and local gene conservation. Proper seed extraction and long-term storage practices are yielding seed viability in excess of 10 years. The average cost to collect whitebark pine seed is $0.33 per seed. Coeur d'Alene Nursery began producing 3-year container whitebark seedlings in 1995, with an estimated production rate of 100 container seedlings per pound of seed. By 2009, nursery efficiencies led to production of 2-year container seedlings both for operations and blister rust resistance testing and an estimated production rate of 1,575 container seedlings per pound of seed.

8. **Extent of Whitebark Pine Habitat in Protected Areas** (Shelly, Mahalovich, Nock)

A large percentage of the occupied habitat for whitebark pine in Region 1 lies in formally protected areas (including Wilderness and Research Natural Areas [RNAs]), and in Inventoried Roadless Areas (IRAs). The total number of acres of Wilderness and IRAs in Region 1 is 8,502,520. Of the 5,085,904 acres with whitebark pine that occur on NFS lands in Region 1, 2,773,620 acres are within Wilderness and IRAs (54.5%). Some forms of restoration management in these protected areas are limited by legal requirements and forest plan standards, as well as access. In addition, 22 established and three proposed RNAs in Region 1 contain whitebark pine. The established RNAs encompass 51,288 acres, and proposed RNAs include 2,483 acres, although not all of this acreage is occupied by whitebark pine. Management in RNAs is allowable as long as it is for the purposes of maintaining or restoring the vegetation types protected in the areas (unless the RNA is located within a Wilderness or other management area that restricts such management activities). A map displaying the distribution of whitebark pine in relation to Wilderness and IRAs is included in **Appendix E**, and the Region 1 RNAs containing whitebark pine are listed in **Appendix F**.

9. **Restoration and protection projects – Regional summary** (Scott, DeNitto, Stewart)

All National Forests in the Northern Region have whitebark pine habitat, and have implemented projects for whitebark pine restoration and protection, some for nearly 20 years. In the past decade there has been greater progress in treating lands to aid in protecting existing whitebark pine trees and stands, reforesting, and monitoring the status of whitebark pine forests. Many landscape analyses conducted to identify project opportunities (pre-NEPA) include projects for the restoration of whitebark pine when the project area has suitable habitat.

Projects have included the direct planting of young seedlings, the removal of competing vegetation and conifers through hand slashing, or removal of merchantable timber. As well, the use of prescribed fire in whitebark pine habitats provides openings for seed caching. Table 2 summarizes these major treatments completed in the Northern Region. Refer to the attachments (**Appendix G**) for details of the project types by fiscal year; the description of projects and the general benefits and expected outcomes; photos of example projects; and a detailed spreadsheet of projects in the National Forests records.

Table 2.

Restoration Treatment 1990-2010	
Tree Planting of WBP	1,482 acres
Release and Young tree thinning to favor WBP	2,321 acres
Harvest to favor WBP	96 acres
Prescribed fire to enhance WBP	10,145 acres

The success of tree planting has improved since the earliest planting efforts in 1991 due to improved planting stock, and selection of planting sites best suited for whitebark pine. Although the sample is small, more recent surveys indicate that 50 to 74% of trees are surviving three summers after they are planted.

Many forests have made an effort to collect cones to plant additional acres. Currently there are 746 pounds of seed in storage at the Forest Service Nursery in Coeur d'Alene, Idaho. This seed would reforest over 3,000 acres.

In addition, the managed use of wildfire (as distinguished from prescribed fire) has been instrumental, even essential, in perpetuating the species. Almost 300,000 acres of fire identified as "fire use" burned between 1998 and 2008, mostly in wilderness and covering many acres of whitebark pine habitat. These fires have promoted whitebark pine and the ecological processes that sustain the species.

For the last seven years, the Region has been protecting whitebark pine by reducing the attack from mountain pine beetle using the pheromone Verbenone or direct protection with Carbaryl, emphasizing trees of high value and those selected for potential genetic resistance ("Plus trees"). The treatment area for many high value trees, such as in campgrounds, are applied by the acre - not every tree is treated but by treating many of the trees, all the trees have protection. The Plus trees, those identified for future cone collection and demonstrating high natural resistance, are being treated over consecutive years during the high mountain pine beetle epidemic. Acres treated are summarized in Table 3.

Table 3.

Tree Protection	Acres
Protection of high value WBP	3,612 acres
Protection of "Plus Trees" for cone collection	1,283 trees

The National Forests have invested in a wide array of assessments and monitoring samples to track recruitment following wildfire, growth in permanent plots with regularly scheduled measurements, and status of understory and overstory whitebark during the ongoing white pine blister rust and mountain pine beetle outbreaks. Over 8,000 acres have specially designed surveys to assess or monitor whitebark pine. Results of these surveys are being used locally to identify project needs and opportunities. Broadscale inventory is conducted through FIA sampling, with details discussed in the status reports.

The Greater Yellowstone Coordinating Committee has embraced the importance of whitebark pine in the Yellowstone area, through collaboration among National Forests from three Regions, two National Parks and several BLM Areas, to assess and manage the whitebark pine ecosystems. The data provided in this report and **Appendix G** reflect this partnership in the project listings.

Projects have been conducted using a variety of funding sources. Congressionally appropriated Forest Service funds for reforestation, stand improvement and fuels treatment are a major source. In recent years, appropriated funds for forest health protection have been available for tree protection and earmarked funds for whitebark pine projects. Region 1 shares the commitment with a variety of partners in accomplishing projects as well. Non-government organizations such as National Arbor Day Foundation, American Forests, and Whitebark Pine Ecosystem Foundation have provided funding to assist in implementation.

Partnering with research organizations has been a very important aspect in restoring whitebark pine as well. National Forest personnel have provided in-kind services to support a variety of studies conducted by Forest Service researchers and from various academic institutions. These partnerships have strong benefits both in treating whitebark pine stands and in furthering the knowledge and understanding of whitebark pine and the associated ecosystems. The effectiveness of treatments is best understood and documented through this research. The recent publication Management Guide to Ecosystem Restoration Treatments by Keane and Parsons[1] is one of the more comprehensive documents to date on project effectiveness after tree removal and/or prescribed fire.

Research, studies and trials continue to be important in increasing the effectiveness of treatments and enhancing current techniques. For example, within the Forest Service, there are ongoing trials to find effective methods for planting seeds (rather than seedlings) that successfully germinate on the field sites, which will greatly enhance the ability to reforest areas with poor access. Nursery propagation techniques are improving by altering treatments for disease common in the two-year greenhouse seedlings, altering seed treatment methods to improve germination consistency, and modifying growing regimes to increase seedlings size and root development.

[1]Keane, Robert E, and Russell A. Parsons. 2010. Management guide to ecosystem restoration treatments: Whitebark pine forests of the Northern Rocky Mountains, U.S.A. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-232. 133 pp.

10. **Whitebark Pine Restoration Program – Forest Health Protection** (Schwandt)

In 2007, the Whitebark Pine Restoration Program was initiated to provide seed money for projects that promoted all phases of restoration. An interdisciplinary team was selected to develop a process to solicit and evaluate restoration proposals. Proposals included development of strategic restoration plans, gene conservation, health monitoring and surveys, silvicultural treatments and planting, as well as educational and public outreach programs. Initial funding from the WO FHP office was $200k but additional FHP Regional contributions greatly expanded this effort. The program has grown every year and although requests far outweigh funding levels, the program has now helped to fund 122 projects that have spent more than $3.5 million on whitebark pine restoration projects throughout the west (Table 4). Since whitebark pine is concentrated in Region 1, the bulk of the projects have occurred in this Region.

Table 4. Whitebark Pine Restoration Program History

	2007	2008	2009	2010	totals
#Projects Requested	56	62	57	40	215
$ Requested	1,005,700	2,179,000	960,851	713,450	4,859,001
$All Match	850,500	1,394,790	878,532	892,980	4,016,802
# Projects Funded	24	26	43	29	122
$ Forest Health Funds	267,400	398,900	517,546	300,200	1,484,046
$ Match for Funded Projects	291,700	433,900	550,000	797,850	2,073,450
TOTAL	**559,100**	**832,800**	**1,067,546**	**1,098,050**	**3,557,496**

The great success of this program has been largely due to the tremendous support by a wide array of cooperators and partners that have more than doubled the FHP funding levels. These include state and private agencies, foundations, and universities, as well as over 30 National Forests across five Regions, and ten national parks (including three in Canada). The Whitebark Pine Restoration Program received the Region 1 Regional Forester's Natural Resources Stewardship Award in 2009. More details of the program and a listing of special projects are included in **Appendix H**.

(**Note:** the above table lists only projects that were submitted to this program. The FHP western bark beetle program also funds about $200K annually for projects dealing with protecting whitebark pine from mountain pine beetle and there are additional Forest Health Monitoring and Special Technical Development Projects that also focus on whitebark pine. In addition, FHP initiated a Gene Conservation Program in 2010 ($200k) to collect cones of five-needled pines and is currently developing a program (Monitoring on the Margins - $200K) to identify and monitor critical populations of high elevation pines on the margins of their ranges. In addition, many National Forests and other agencies fund projects outside the purview of this program, so the totals in this table represent only a portion of all funds spent on whitebark pine each year.)

11. **Wildland fire use for resource benefit** (Shelly, Stewart, Nock)

In May, 2009, Region 1 issued a letter to the National Forests regarding the management of unplanned ignitions for whitebark pine restoration. The purpose of the letter was to highlight opportunities where wildfire can be used to meet restoration needs for the species. The letter included a technical overview describing the desired conditions, objectives, and specific management approaches for this purpose. It also included a map delineating portions of the range where the use of wildland fire for such resource benefit is allowed under current forest and fire management plans in Region 1. The letter, technical overview, and map layers are included in **Appendix I**.

A GIS analysis of whitebark pine habitat burned in wildland fires in Region 1 indicates that 279,919 acres burned during the period from 1988-1998, and 480,084 acres burned during 1999-2009. The total acres burned in wildland fires over the 22-year period was 760,003. Some of these acres experienced fire more than once. Yearly figures are available for this period, and are included in

Appendix I. The majority of the acres were burned in the four major fire years during the period (1988, 2000, 2003, and 2007).

Risk factors

Present or threatened destruction, modification, or curtailment of habitat or range

The modification and curtailment of range that is resulting from various disturbances is summarized in preceding sections.

Overutilization for commercial, recreational, scientific, or educational purposes

Not applicable for Region 1.

Disease or predation

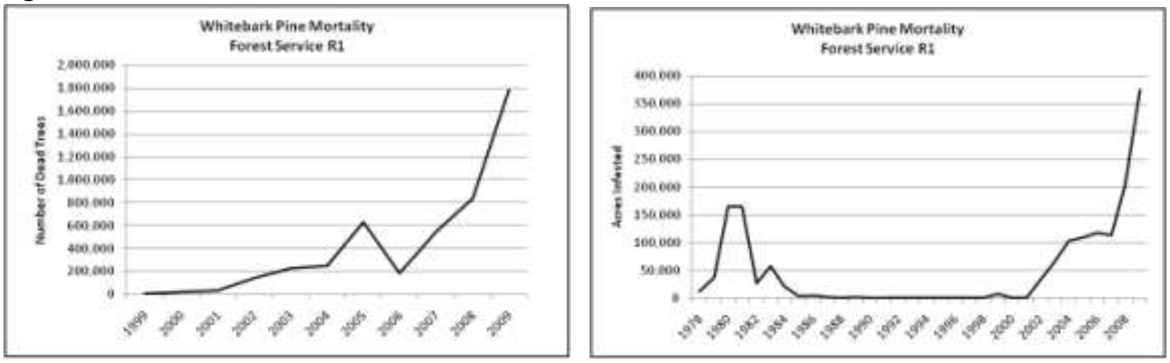
12. Aerial Detection Surveys – Mountain Pine Beetle Mortality (DeNitto)

The Forest Service annually conducts an aerial survey to detect damaging agents other than fire to forested lands of all ownerships. This survey attempts to identify location, quantity, host, and causal agents involved. Most forested lands in the Region are surveyed, but there is variation between years. Some years, such as 2000 and 2006, have much more limited coverage because of the complications of factors such as fires. Although not a precise, statistical method of inventory, aerial survey is the most efficient, cost-effective, and consistent method to survey tree damage available. The Forest Service has this type of data across the western United States for at least the past decade.

Based partly on these surveys, we began observing increasing whitebark pine mortality around 2001, which has continued to increase until the present as indicated in the graphs below. Ground observations indicate most of this mortality is from mountain pine beetle activity. The year of observation indicates the presence of trees with red foliage, while the actual mountain pine beetle attack occurs the year prior to aerial detection. The decline in 2006 is an artifact of the limited area surveyed that year, and we believe there was an increase in mortality that was not captured by this survey methodology. The acres infested are not cumulative over time, but rather indicate some level of tree mortality in a particular year. That same acre may experience mortality over a period of several years.

The graphs (Figure 9) suggest a continued increase in whitebark pine mortality, but we know of many areas where susceptible trees are becoming limited in number. We expect to see a decrease in this level of mortality over the next several years as the susceptible host population declines in many areas. A breakdown of these data by ownership class for the more recent mountain pine beetle outbreak is shown **Appendix J**. More detailed aerial survey GIS data can be downloaded from http://www.fs.fed.us/r1-r4/spf/fhp/aerial/gisdata.html.

Figure 9.



13. **Mountain Pine Beetle and White Pine Blister Rust Surveys** (DeNitto, Schwandt, Lockman)

In addition to surveys and evaluations on mountain pine beetle and white pine blister rust mentioned elsewhere in this summary, the Forest Service has conducted or funded more site- specific surveys that may provide useful data for the status review. The results of most of these surveys have not been formally published in the scientific literature, but have been reported in office documents. These surveys have occurred during the past 10 years and some are still underway. In general, they confirm and quantify other observations that indicate the increase in whitebark pine mortality from mountain pine beetle and the presence of white pine blister rust in much of the whitebark pine population in the Region. A summary of these surveys, the principal investigators, and sources for further information on each study are identified in **Appendix K**.

14. **Mortality trends from FIA data (Bush, Lundberg)**

Estimates of whitebark pine (PIAL) using FIA data for Region 1

Overview of Forest Inventory and Analysis Data:

The national Forest Inventory and Analysis (FIA) program provides a congressionally mandated, statistically-based, continuous inventory of the forest resources of the United States. The FIA inventory design is based on a spatially-balanced sample of inventory plots. Data about trees, and associated characteristics are collected on all forested portions of the plots, throughout the United States, regardless of ownership. The FIA sampling frame uniformly covers all forested lands, regardless of management emphasis. Therefore, wilderness areas, roadless areas, and actively managed lands all have the same probability of being sampled. Data collection standards are strictly controlled by FIA protocols. The sample design and data collection methods are scientifically designed, publicly disclosed, and repeatable. Data collection protocols are available on the internet (http://www.fia.fs.fed.us/). There are also stringent quality control standards and procedures, carried out by FIA personnel of the Rocky Mountain Research Station, which oversee the FIA data collection for Region 1 (R1). All of this is designed to assure that data is collected consistently throughout the United States, and that stated accuracy standards are met by the field crews

FIA provides a statistically-sound representative sample designed to provide unbiased estimates of forest conditions at broad- and mid-levels. A statistical sample provides the means to observe a randomly selected subset of the entire population and make inferences about the entire population. Since variability exists across a landscape, statistical sampling provides metrics to determine how accurately the estimates apply to the entire population. Statistical sampling provides methods for estimating population characteristics and evaluating the reliability of the estimates. The variability of the attribute of interest, number of plots analyzed, and the size of the plots affect the reliability of the estimate.

FIA plot design and layout has changed over the years. From 1992-1998, an FIA plot consisted of a cluster of 5-7 subplots. The number of subplots installed depended upon the year of inventory; early inventories had a seven-point cluster, whereas later inventories had 5 points.
Trees 5” diameter breast height (DBH) and larger were selected with a basal-area factor of 40. Furthermore, if major differences in forest type or structure were observed from one subplot to the next, the subplots were “rotated” into the same condition as subplot 1. For example if subplot 1 was timber and subplot 2 was a clearcut, subplot 2 was rotated into a timber condition following specific protocols. This design was used in Montana from 1992 – 1998 for Forests whose majority of the lands they administer were in the state of Montana. After 1996, FIA adopted a national plot layout consisting of 4 fixed-radius (24^{th} acre) subplots. Subplots are no longer rotated, instead general forest conditions about structure and type are recorded on each sub-plot. This design was used to measure the periodic inventory for those Forests that whose majority of acres are in the state of Idaho and for the present annual inventory. Until 2003, the FIA inventory was implemented in a periodic manner; all of the plots, on any given Forest, were measured within a 1-2 year time frame (see Table 5). In 2003, the annual inventory began in Montana and the following year in Idaho. The current annual FIA procedures use the mapped-plot design but 10% are measured, in a spatially balanced manner, across all Forests every year. Therefore, all Forests have plots measured yearly with all plots on a Forest measured in a 10-year time frame.

Table 5: Date of Periodic FIA Inventory by R1 National Forest

National Forest	**Date of FIA Periodic Inventory**
Eastern Montana	
Beaverhead-Deerlodge	1996-1997
Custer	1997
Helena	1996-1998
Gallatin	1997-1998
Lewis & Clark	1996-1997
Western Montana	
Bitterroot	1994-1995
Flathead	1993-1994
Kootenai	1993-1997
Lolo	1995-1996
Northern Idaho	
Idaho Panhandle	2000-2003
Clearwater	1998-2002
Nez Perce	2000-2002

Using FIA data to assess the amount of live and dead whitebark pine (PIAL) allows the Region to assess the amounts and status of PIAL in an unbiased, statistically sound, independently designed and implemented representative sample of forest lands. However, since the sample design of FIA plots has changed from the variable radius to the mapped-plot design, for most of the Forests, the same trees are not remeasured from the periodic to the annual inventory. Therefore, actual trends of individual trees cannot be assessed. Once the Annual Inventory has been fully installed and remeasured, these types of analysis can be done.

Table 6 displays the number of FIA plots and the percent of the total FIA plots for the Region and by Forest that have at least one whitebark pine tree reported on the plot. When comparing periodic versus annual data, it is best to compare the percentages and not the total number of plots because not all of the annual plots have been installed in Region 1.

Table 6: Number and percent of Periodic and Annual FIA plots for Region 1 and by Forest with live, dead, and both live or dead PIAL trees.

Periodic FIA									
	Live PIAL			Dead PIAL			Live and/or Dead PIAL		
	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL
R1	709	3875	18.3%	330	3875	8.5%	736	3875	19.0%
Beaverhead-Deerlodge	194	546	35.5%	75	546	13.7%	194	546	35.5%
Bitterroot	75	252	29.8%	34	252	13.5%	78	252	31.0%
IPNF	13	411	3.2%	4	411	1.0%	16	411	3.9%
Clearwater	14	305	4.6%	11	305	3.6%	17	305	5.6%
Custer	27	195	13.8%	13	195	6.7%	29	195	14.9%
Flathead	94	382	24.6%	59	382	15.4%	99	382	25.9%
Gallatin	112	285	39.3%	45	285	15.8%	114	285	40.0%
Helena	31	149	20.8%	13	149	8.7%	31	149	20.8%
Kootenai	8	365	2.2%	3	365	0.8%	9	365	2.5%
Lewis & Clark	53	299	17.7%	24	299	8.0%	56	299	18.7%
Lolo	60	347	17.3%	29	347	8.4%	61	347	17.6%
Nez Perce	28	339	8.3%	20	339	5.9%	32	339	9.4%
Annual FIA									
	Live PIAL			Dead PIAL			Live and/or Dead PIAL		
	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL	# Plots w/ PIAL	Total # FIA Plots	% total plots with PIAL
R1	302	1914	15.8%	199	1914	10.4%	332	1914	17.3%
Beaverhead-Deerlodge	92	291	31.6%	46	291	15.8%	95	291	32.6%
Bitterroot	28	128	21.9%	19	128	14.8%	32	128	25.0%
IPNF	2	164	1.2%	0	164	0.0%	2	164	1.2%
Clearwater	6	124	4.8%	4	124	3.2%	7	124	5.6%
Custer	9	90	10.0%	5	90	5.6%	10	90	11.1%
Flathead	39	189	20.6%	38	189	20.1%	48	189	25.4%
Gallatin	47	166	28.3%	35	166	21.1%	49	166	29.5%
Helena	15	80	18.8%	7	80	8.8%	15	80	18.8%
Kootenai	4	203	2.0%	4	203	2.0%	5	203	2.5%
Lewis & Clark	27	152	17.8%	18	152	11.8%	31	152	20.4%
Lolo	26	184	14.1%	20	184	10.9%	30	184	16.3%
Nez Perce	7	143	4.9%	3	143	2.1%	8	143	5.6%

Figures 10-12 present graphics for the information displayed in table 2.

Figure 10: Comparison of percent of Periodic and Annual FIA plots in Region 1 and by Forest with live PIAL on the plot.

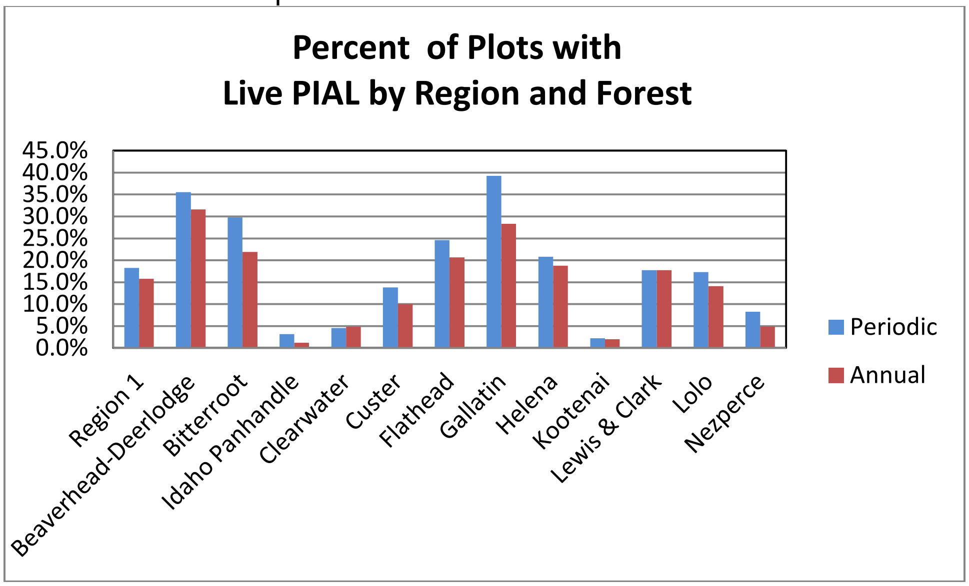


Figure 11: Comparison of percent of Periodic and Annual FIA plots in Region 1 and by Forest with dead PIAL on the plot.

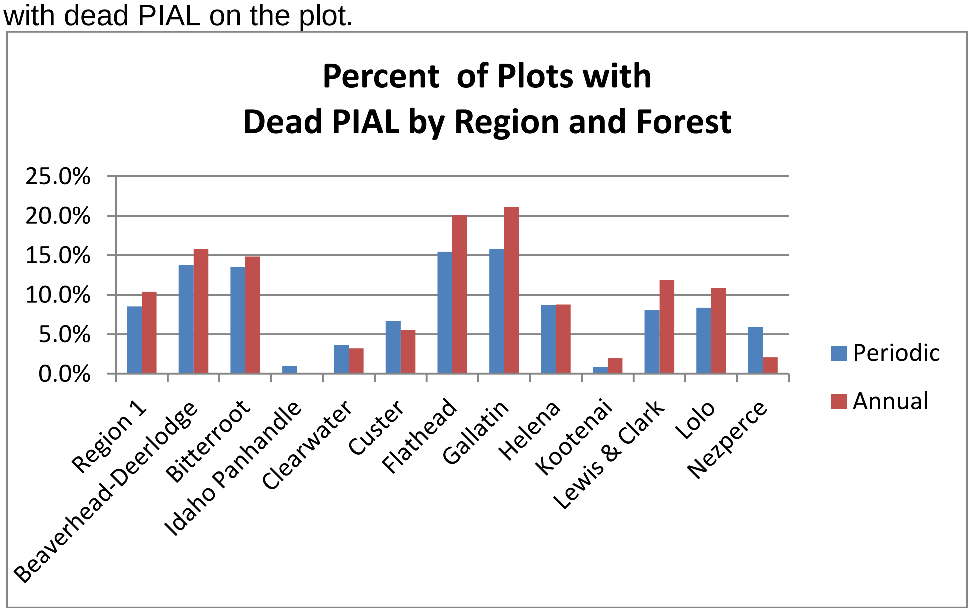
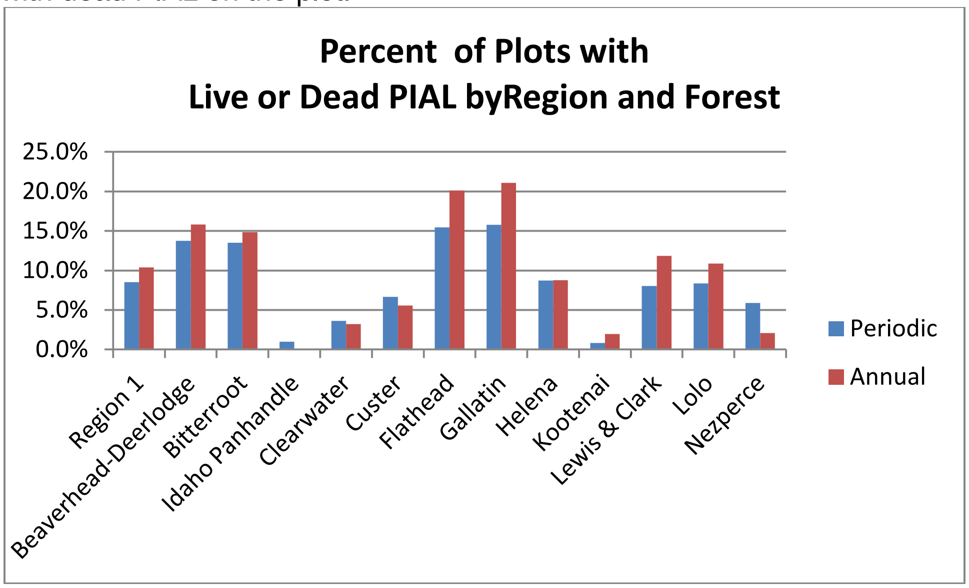
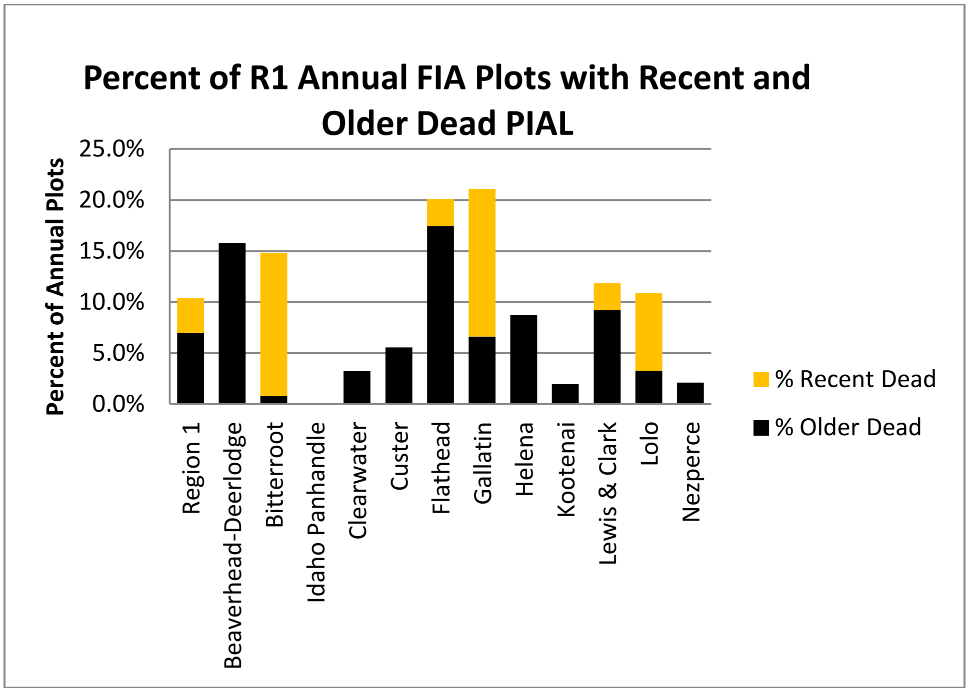


Figure 12: Comparison of percent of Periodic and Annual FIA plots in Region 1 and by Forest with dead PIAL on the plot.



The incidence of dead whitebark pine was further explored by looking whether recent mortality had occurred on a plot. This analysis explored the annual FIA plots. Recent mortality is recorded if a tree has died mortality within the last 5 years (at time of inventory). If recent mortality had occurred on a plot, then the plot was called “recent dead”. It should be noted that plots that had recent mortality may have also had dead whitebark pine on them that had died more than 5 years from the time of inventory. If the plot only had older mortality in whitebark pine, it was considered “older dead”. Figure 13 displays the percent of annual FIA plots that have recent and older dead occurring for the Region and by Forest.

Figure 13: Comparison of percent of Annual FIA plots in Region 1 and by Forest with recent dead (and potentially older dead) whitebark pine vs. just older dead whitebark pine on the plot.



The FIA plots were then explored to look at the occurrence of whitebark pine by elevation classes. Figures 14 and 15 explore the occurrence of whitebark pine (both live and dead) by Forest and by geographic area, which are groups of Forests. Figure 16 displays the occurrence of dead and live whitebark pine by geographic area and elevation classes.

Figure 14: Occurrence of whitebark pine (either live or dead) by elevation classes by Region and Forests.

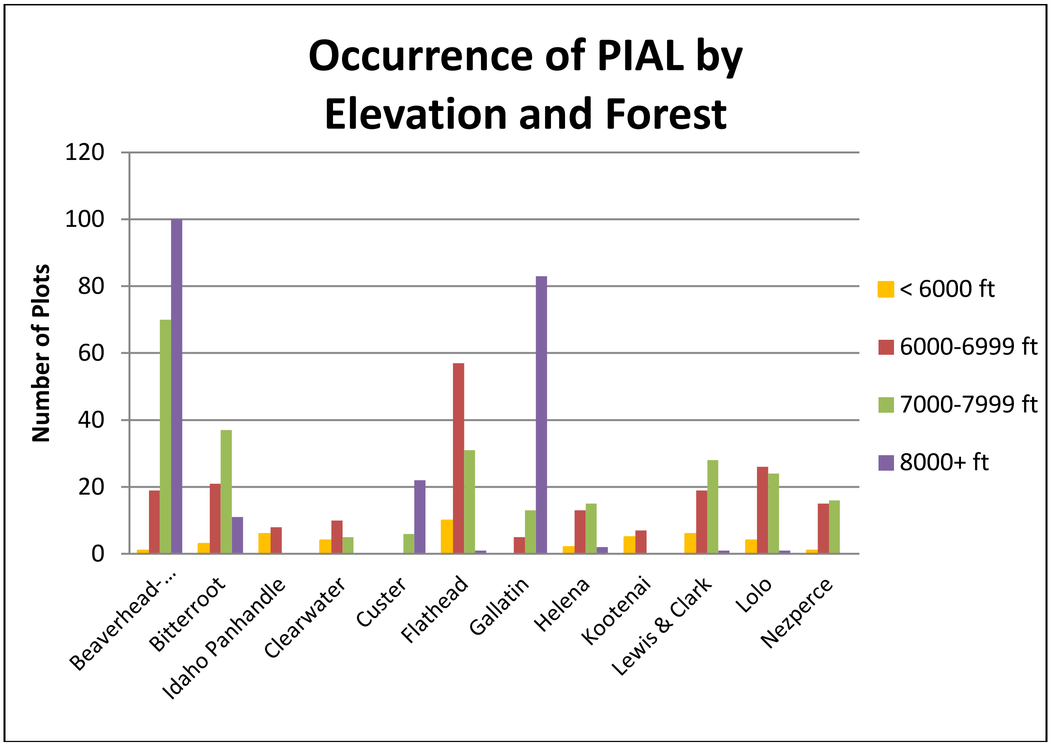


Figure 15: Occurrence of whitebark pine (either live or dead) by elevation classes and geographic areas; eastern Montana, northern Idaho, and western Montana.

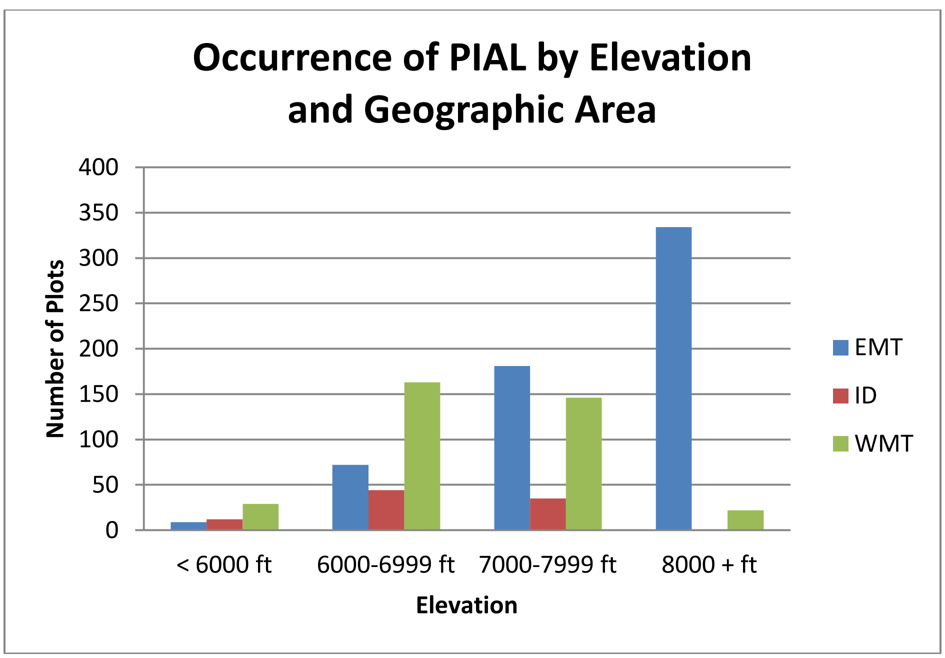
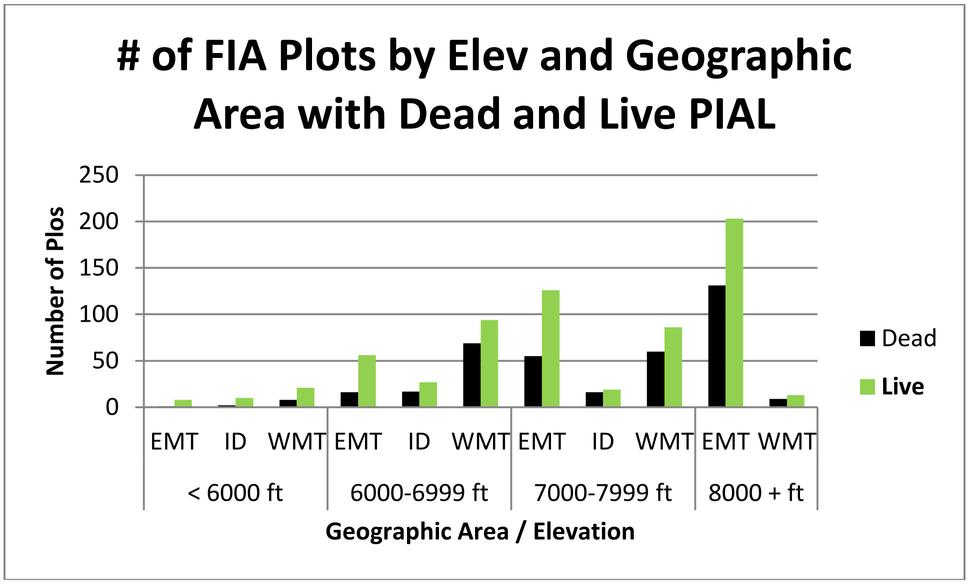


Figure 16: Occurrence of live and dead whitebark pine by elevation classes and geographic areas - eastern Montana, northern Idaho, and western Montana.



Inadequacy of existing regulatory mechanisms

***15.* Forest Plan information summary (Scott)**

All 12 National Forests in Region 1 were queried regarding whether whitebark pine is addressed in their current land management plans. At the present time, only one Forest plan (Beaverhead-Deerlodge NF) includes specific objectives and standards for whitebark pine; this Forest plan was revised in 2009. The remaining plans were developed in the 1980s, prior to the present-day focus on whitebark pine. In some cases (e.g., Idaho Panhandle NFs), commercial timber land planned for timber management was defined in the current plans in such a way (based on elevation and potential productivity) that most whitebark pine habitat was excluded. As the remaining Forests revise their plans over the next few years, restoration of whitebark pine will be addressed, and most whitebark pine habitat will not be part of the commercial timber base. The importance of whitebark pine for wildlife species (especially grizzly bear and Clark's nutcracker) will also be addressed. Existing Forest plan direction for Wilderness Areas and Inventoried Wilderness Areas applies to whitebark pine habitat where it occurs in these areas.

In conjunction with their revised Forest plan, the Beaverhead-Deerlodge NF has developed a 10-year program of work for planting of whitebark pine. The total acreage targeted for planting during this period is 3,550. Year-to-year acreage will be dependent on available cone crops.

Other natural or manmade factors affecting its continued existence
None at this time.

Potential effects of climate change on this species and its habitat

16. Climate and white pine blister rust (Schwandt)

(from: *2010. J. W. Schwandt, I. B. Lockman, J. T. Kliejunas and J. A. Muir. Current health issues and management strategies for white pines in the western United States and Canada. Journal of Forest Pathology 40: 226-250*.)

Climatic changes over the next century could significantly affect white pine populations both directly and through influences on bark beetles, blister rust, and other pathogens (Campbell and Carroll 2007; Kliejunas et al. 2009). These complex interactions present serious complications for maintaining the distribution and importance of white pines in western North America.

A warmer climate could be especially detrimental to whitebark pine. In a warmer climate, the species' fundamental habitat would shift to cooler sites at higher elevations and higher latitudes. Whitebark pine could persist on the landscape—if such habitats existed, if sufficiently rapid migration were possible, and if the species were sufficiently capable of adapting. Warwell et al. (2007) used a conservative model of climate change and found a greatly reduced area of suitable, future habitat for whitebark pine. The likelihood of sustaining whitebark pine, even in suitable habitats, is further diminished if populations are small (owing to random events, the Allee effect, see Scherm et al. 2006).

An important constraint on mountain pine beetle outbreaks in whitebark pine is climate, especially the frequency of severely cold winters and brief warm summers (Campbell and Carroll 2007). In warmer winters, more brood could survive; and, with a sufficiently long season, two generations per year could be produced (Bentz and Schen-Langenheim 2006; Gibson et al. 2008). Although mountain pine beetle already produces two generations per year in sugar pine, the consequence of doubling the reproductive potential in a subalpine forest of whitebark pine rather than a montane forest of sugar pine is not readily apparent.

Changes in timing and duration of warmth and moisture could have major influences on the epidemiology of *C. ribicola*. By some climate scenarios, summers are drier in the Rocky Mountains but wetter in the Southwest (Bartlein et al. 1997; Kliejunas et al. 2009). As infection of white pine by blister rust requires a cool, moisture-saturated environment, conditions suitable for infection in some regions might be restricted to fewer wet periods in spring or early summer but extended in other regions. Early season infection of pine is common for infestations in the coastal regions of British Columbia (Hunt 2005). In the southern Sierra Nevada, infection of white pine normally coincides with spring rains and summer thunderstorms (Kinloch and Dulitz 1990). A sufficiently long and cool winter is required before Ribes break dormancy and become susceptible, telial hosts (Zambino 2010). Climatic change may also have a major effect on other pathogens such as those causing foliage disease (Kliejunas et al. 2009). For example, if increased warmth was accompanied by increased moisture, defoliation by Dothistroma may lead to widespread mortality, as occurs to lodgepole pine in British Columbia (Woods et al. 2005).

Literature Cited (Climate and white pine blister rust):

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